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Impact of Information and Communication Technologies (ICTs) on agriculture practices

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ABSTRACT

The present study was carried out in four districts of Haryana state, i.e. Yamunanagar, Karnal, Hisar and Fatehabad which were selected randomly. In total 240 respondents, viz. 60 farmers from each district, 30 farmers from each block and 15 farmers from each village were selected for present study. Majority of farmers used ICTs for knowing source of quality seeds, suitable high-yielding variety for the specific area. Most of the farmers used ICTs in nursery management for plant protection measures, method of preparing bed and nutrient management. Farmers used ICTs for the information purpose like price of fertilizers and stock of fertilizers. Farmers used ICTs for chemical weed management, price of weedicides, and place of availability, trade names and stock availability. ICTs use for the information purpose, for scheduling irrigation followed by to know critical stages of irrigation application and fertilizer management during irrigation. Farmers used ICTs for identification, nature of damage and control measures for insects/pests of different crops. Majority of the farmers used ICTs for the purpose of information, ideal thrasher for thrashing of crops followed by proper timing of harvesting. The correlation and regression of different variables, i.e. education, socio-economic status, land holding, extension contact, mass media exposure, scientific orientation, economic motivation and risk orientation exhibited positive and significant effect, whereas age exhibited negative and significant effect. However, irrigation facilities exhibited non-significant effect but it positively correlated with agricultural practices.

Key words: ICTs and protection measures, Irrigation, Varieties

Information and communication have always mattered in agriculture. Agriculture is facing new and severe challenges in its own right. Rising food prices that have pushed over 40 million people into poverty since 2010, more effective interventions are essential in agriculture (World Bank 2011). The growing global population, expected to hit 9 billion by 2050, has heightened the demand for food and placed pressure on already-fragile resources. Feeding that population will require a 70% increase in food production (FAO 2009). Given the challenges, the arrival of information communication technology (ICT) is well timed. The benefits of the green revolution greatly improved agricultural productivity. However, there is a demonstrable need for a new revolution that will bring lower prices for consumers (through reduced waste and more-efficient supply chain management), contribute to "smart" agriculture, and incentivize farmers (for example, through higher income) to increase their production. Public and private sector actors have long been on the search for effective solutions to address both the long- and short-term challenges in agriculture, including how to answer the abundant information needs of farmers. ICT is one of these solutions, and has recently unleashed incredible potential to improve agriculture in developing countries specifically. Technology has taken an enormous leap beyond the costly, bulky, energy-consuming equipment once available to the very few to store and analyze agricultural and scientific data. With the booming mobile, wireless, and Internet industries, ICT has found a foothold even in poor smallholder farms and in their activities. The ability of ICTs to bring refreshed momentum to agriculture appears even more compelling in light of rising investments in agricultural research, the private sector's strong interest in the development and spread of ICTs, and the upsurge of organizations committed to the agricultural development agenda.

MATERALS AND METHODS

The present study was carried out in four districts of Haryana state, i.e. Yamunanagar, Karnal, Hisar and Fatehabad, which were selected randomly. Radaur and Chhachroli blocks from Yamunnanagar and Indri and Nilokheri from Karnal districts whereas Bakana and Kandroli villages from Radaur and Bhagwanpur and Sherpur from Chhachroli; Kalri and Kukhnai from Nilokheri were

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selected. Hisar I and Hisar II and Bhattu and Fatehabad blocks selected with villages Sathrod and Mizapur from Hisar I and Balsamand and Budhak from Hisar II; Dhand and Bnawali from Bhattu and Daulatpur and Hizrawan from Fatehabad were selected. Thus, 16 villages were selected randomly from eight blocks. In total 240 respondents, viz. 60 farmers from each district, 30 farmers from each block and 15 farmers from each village were constituted the sample size for present study. Keeping in view the nature of data, objectives of the study and applicability of the tests were used for analysis and interpretation of data. Computer facilities were availed to work out percentage, weighted mean, coefficient of correlation, multiple regression analysis etc. The correlation coefficient between the dependent and independent variables was calculated with the help of Pearson's formula of correlation coefficient. Multiple regression equation was fitted to find out the amount of variation caused by independent variables constituting personality traits of respondents on dependent variables. On the basis of statistical analysis, conclusions were drawn and report writing was done keeping in view the objectives of the study.

RESULTS AND DISCUSSION

Effect of ICTs on information of varieties, land preparation and sowing

An examination of the data presented in Table 1 indicates the use of ICTs by farmers for the purpose of information of varieties. The data showed that majority of farmers use ICTs as source of seeds (1.36) followed by suitable high yielding variety for the area (1.30), rate of seeds (1.27), stock of seeds (1.16), characteristics of high yielding variety (1.03) respectively. Overall impact of ICTs on the information of varieties was (1.22) found positive. Table 2 shows that farmers used ICTs for the information of preparation of seedlings. The data revealed that most of farmers use ICTs for plant protection in nursery management (0.94), method of preparing bed for nursery (0.80), nutrient management in nursery (0.73), select site for raising seedlings (0.72), proper age to select seedlings for transplanting (0.70) and irrigation management in nursery (0.69). Total impact of ICTs on information of preparation of seedlings was 0.76 which indicates the positive impact of ICTs. The presented data in Table 3 shows that the farmers used ICTs for the information of land preparation and seedling. The data in table show that majority of the farmers used ICTs for the information of sowing time (0.82) followed by the soil treatment (0.75), spacing (0.75), seed rate (0.71), seed treatment inputs (0.70), land preparation (0.69), price of soil treatment inputs (0.68), place of availability of soil treatment inputs (0.65), depth of sowing (0.63), method of sowing (0.63). The total impact in Table 3 was found 0.70 of ICTs. Similar finding was also observed by Aker (2011) explains that the use of mobile phones provides new opportunities for farmers to obtain access to agricultural information, such as market prices, weather reports, transport information and agricultural techniques, in various formats like audio (voice), video (internet), and text (SMS).

Effect of ICTs on fertilizer, weed, irrigation management, plant protection management and harvesting

Table 4 indicates use of ICTs for the purpose of information of fertilizer management by farmers. The data showed that farmers used ICTs for the purpose of information of price of fertilizers (0.88), stock of fertilizers (0.82), place of availability of fertilizers (0.81), name of advantageous chemical fertilizers for crop (0.80), method and time of fertilizer application (0.79), calculating the dose of chemical fertilizer (0.77), nutrient requirements of

Table 1 Impact of ICTs on the information of varieties

Area of Information	Always (2)	Sometime (1)	Never (0)	Total weighted frequency score	Weighted mean	Average weighted mean
Source of Seeds	140(280)	47	53	327	1.36	1.22
Suitable high yielding variety for the area	125(250)	62	53	312	1.30	
Rate of seeds	117(234)	70	53	304	1.27	
Stock of Seeds	92 (184)	95	53	279	1.16	
Characteristics of high yielding variety	59 (118)	128	53	246	1.03	

Figures in parentheses indicate weighted score.

Table 2 Impact of ICTs on the information of preparation of seedling of crops

Area of information	Always (2)	Sometime (1)	Never (0)	Total weighted frequency score	Weighted mean	Average weighted mean
Select site for raising seedling	44(88)	85	111	173	0.72	0.76
Method of preparing bed for nursery	63(126)	66	111	192	0.80	
Plant protection in nursery management	96(192)	33	111	225	0.94	
Nutrient management in nursery	46(92)	83	111	175	0.73	

Figures in parentheses indicate weighted score.

Table 3 Impact of ICTs on the information of land preparation and sowing

Area of information	Always (2)	Sometime (1)	Never (0)	Total weighted frequency score	Weighted mean	Average weighted mean
Land preparation	32(64)	101	107	165	0.69	0.70
Soil treatment	48(96)	85	107	181	0.75	
Place of availability of soil treatment inputs	24(48)	109	107	157	0.65	
Seed rate	37(74)	96	107	170	0.71	
Price of Soil treatment inputs	31(62)	102	107	164	0.68	
Sowing time	63(126)	70	107	196	0.82	
Depth of sowing	18(36)	115	107	151	0.63	
Method of sowing	18(36)	115	107	151	0.63	
Spacing	47(94)	86	107	180	0.75	
Seed treatment inputs	35(70)	98	107	168	0.70	

Figures in parentheses indicate weighted score.

Table 4 Impact of ICTs on the information of fertilizer management

Area of information	Always (2)	Sometime (1)	Never (0)	Total weighted frequency score	Weighted mean	Average weighted mean
Price of fertilizers	78(156)	45	117	201	0.88	0.77
Stock of fertilizers	73(146)	50	117	196	0.82	
Place of availability of fertilizers	72(144)	51	117	195	0.81	
Name of advantageous chemical fertilizers for crop	68(136)	55	117	191	0.80	
Method and time of fertilizer application	66(132)	57	117	189	0.79	
Calculating the dose of chemical fertilizer	63(126)	60	117	186	0.77	
Nutrient requirements of plant	59(118)	64	117	182	0.76	
Deficiency symptoms of major plant nutrients	55(110)	68	117	178	0.74	
Bio-fertilizer	51(102)	72	117	174	0.72	
Making organic matter from farm waste	46(92)	77	117	169	0.70	
Organic manures	36(72)	83	117	155	0.66	

Figures in parentheses indicate weighted score.

plant (0.76), deficiency symptoms of major plant nutrients (0.74), bio-fertilizer (0.72), making organic matter from farm waste (0.70), organic manures (0.66). The total impact of information was found 0.77.Table 5 study the usage pattern of ICTs by farmers for the purpose of information of weed management. The data revealed that farmers use of ICTs for chemical weed management (0.78), price of weedicides (0.76), place of availability of weedicides (0.74), trade name of weedicides (0.72) and stock of weedicides (0.70). The total impact of ICTs on weed management was found 0.74. Same result reported by Mittal *et al*. (2010) that the broad categories of information required by farmers, irrespective of their location and crops could be categorized as know-how, which helped a farmer with fundamental information such as time of sowing and selection of quality seed varieties; contextual information such as weather, suitable agronomic practices for cultivation in the locality; and market information such as prices, demand indicators, and logistical information.

Farmers' use of ICTs for the purpose of information regarding irrigation management is presented in Table 6. The data show that majority of the farmers used ICTs for the purpose of scheduling irrigation (0.79) followed by critical stages of irrigation (0.77), fertilizer management during irrigation (0.75), life saving irrigation during shortage of water (0.71) and method of irrigation (0.70). The total impact was studied 0.74 of ICTs on irrigation management. The findings in Table 7 revealed the usage of ICTs for the purpose of plant protection measures by the farmers. The data showed that farmers used ICTs for the identification of insect pest incidence, nature of damage and control measures (1.15). Identification, nature of damage and control measures for diseases of crops (1.10), price of insecticides and pesticides (1.07), integrated pest management of crops (1.05), method for preparation solution of insecticides/pesticides (1.03), trade name of insecticides/pesticides (1.00) and place of availability of insecticides and pesticides (0.96). The overall impact of ICTs on the information of plant protection was

Table 5 Impact of ICTs on the information of weed management

Area of information	Always (2)	Sometime (1)	Never (0)	Total weighted frequency score	Weighted mean	Average weighted mean
Chemical weed management	69(138)	49	122	187	0.78	0.74
Price of weedicides	65(130)	53	122	183	0.76	
Place of availability of weedicides	59(118)	59	122	177	0.74	
Trade name of weedicides	54(108)	64	122	172	0.72	
Stock of weedicides	50(100)	68	122	168	0.70	

Figures in parentheses indicate weighted score.

Table 6 Impact of ICTs on the information of irrigation management

Area of information	Always (2)	Sometime (1)	Never (0)	Total weighted frequency score	Weighted mean	Average weighted mean
Schedule for irrigation	74(148)	42	124	190	0.79	0.74
Critical stages of irrigation	69(138)	47	124	185	0.77	
How to save crop during shortage of water	55(110)	61	124	171	0.71	
Fertilizer management during irrigation	63(126)	53	124	179	0.75	
Method of irrigation	51(102)	65	124	167	0.70	

Figures in parentheses indicate weighted score.

Table 7 Impact of ICTs on the information of plant protection

Area of information	Always (2)	Sometime (1)	Never (0)	Total weighted frequency score	Weighted mean	Average weighted mean
Identification , nature of damage and control measures for insects/pests of crops	108(216)	60	72	276	1.15	0.91
Identification , nature of damage an control measures for diseases of crops	97(194)	71	72	265	1.10	
Price of insecticides and pesticides	89(178)	79	72	257	1.07	
Integrated pest management of crops	84(168)	84	72	252	1.05	
Method of preparation solution of insecticides/pesticides	79(158)	89	72	247	1.03	
Trade name of insecticides /pesticides	73(146)	95	72	241	1.00	
Place of availability of insecticides and pesticides	63(126)	105	72	231	0.96	

Figures in parentheses indicate weighted score.

0.91 which was found positive. The data in Table 8 revealed that majority of the farmers used ICTs for the selection of ideal thrasher suitable for thrashing of different crops (0.71) followed by proper timing of harvesting (0.69), how to store harvested crops (0.66), post harvest measure at farming level (0.64) and precaution during harvesting (0.63). The total impact of ICTs on harvesting and post-harvesting technology was found 0.67. Similar results were reported by Ganesan *et al*. (2013) that the majority of farmer perceived information on pest and disease control as 'most important' and accessing information through mobile phone was easy and convenient. Although there were perceived benefits by farmers, the quality, timeliness and reliability of information were important aspects that have to be considered seriously to meet their requirements and prospects.

Correlation between respondent's personal variables and usages of ICTs

The correlation and regression coefficient presented in Table 9 show relationship between agricultural practices and personal variables of farmers. Correlation among 10 variables, eight variables, i.e. education (0.647), socio-economic status (0.666), land holding (0.086), extension contact (0.652), mass media exposure (0.666), scientific orientation (0.326), economic motivation (0.630) and risk orientation (0.214) exhibited positive and significant effect, whereas age (0.648) exhibited negative significant effect. However irrigation facilities (0.095) showed non-significant effect but it was positively correlated with agricultural practices. Similarly, regression coefficient of variables education (0.214), socio-economic status (2.228), land

Table 8 Impact of ICTs on the information of harvesting and post harvesting technology

Area of information	Always (2)	Sometime (1)	Never (0)	Total weighted frequency score	Weighted Mean	Average weighted mean
Proper timing of harvesting	58(116)	51	131	167	0.69	0.67
Ideal thrasher for thrashing of crops	61(122)	48	131	170	0.71	
How to store	51(102)	58	131	160	0.66	
Care after harvesting at farming level	45(90)	64	131	154	0.64	
Care during harvesting	41(82)	68	131	150	0.63	

Figures in parentheses indicate weighted score

Table 9 Relationship between respondent's personal variables and usages of ICTs for agriculture practice by farmers

Variables	Correlation coefficient (r)	Regression coefficient	't' values
Age	-0.648*	-0.589	-1.362*
Education	0.647**	0.747	0.214*
Socio-economic status	0.666**	2.905	2.228**
Landholding	0.086*	0.584	0.397*
Irrigation facilities	0.095 NS	-0.871	-0.580*
Extension contact	0.652**	0.733	0.366*
Mass media exposure	0.666**	2.126	0.786*
Scientific orientation	0.326*	-1.158	0.842*
Economic motivation	0.630**	-4.088	1.787*
Risk orientation	0.214*	0.473	0.304*

* Significant at P=0.05 and, ** Significant at P=0.01 R^2=0.4660

holding (0.397), extension contact (0.366), mass media exposure (0.786), scientific orientation (0.842), economic motivation (1.787) and risk orientation (0.304) exhibited positive and significant effect, however age (1.362) and irrigation facilities (0.580) was found negatively correlated with agricultural practices. The results was in agreement with Rajpoot *et al*. (2016) who concluded that impact of "ICTs mediated agricultural extension service" on gain in knowledge and level of adoption of respondents, regarding the selected package of cultivation practices for rice crops was found significant. Mittala *et al*. (2015) showed that socio-economic characteristics of farmers like age, level of education and farm size were significantly related to different sources of agricultural information. More simply, using these results, information providers can better anticipate information in combination with other information sources. These results showed the complement effect on the use of different sources of information.

Conclusion

The availability of high-yielding varieties and their price was always uncertain for farmers but the use of ICTs by farmers helps to get the information about varieties that gives higher outcomes. Lack of technical knowledge about nursery management forced the farmers to switch on ICTs for the preparation of seedling, land preparation. The ICTs leads to inform about initial seed treatment that must decrease the incidence of seed-borne diseases. Nutrients are essential for better growth and so on for higher yields, usage of ICTs for fertilizer management. Weed management is important for higher yield and quality grains, so farmers used ICTs for chemical weed management, price related information, and knowing the place of availability of weedicides. Farmers used ICTs for scheduling irrigation, to know critical stages of crop growth to apply irrigation and fertilizer management in accordance with irrigation scheduling. Farmers used ICTs for identification of insects or diseases incidence, nature of damage and control measures in different crops as many problems of heavy infestations of insects and diseases were faced by farmers. Majority of farmers used ICTs for the purpose of harvesting and post harvesting management, selection of ideal thrasher for thrashing of particular crop, proper timing of harvesting and storage.

The inferences drawn in this paper need further exploration with farmers through experimental research. Overall, the farmers rely on multiple sources of information, but they still continue to extensively use other farmers and face-to-face interactions. We also do not deny the fact that successful use of information as a resource for agricultural development depends largely on the accessibility and adequacy of the information source, farmers' preference for a particular information source and farmer's ability to use information.

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